SMD Operations Procedures Manual

8.1.1.19 OPERATION OF SHORT COIL WINDER

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8.1.1.19 Operation of Short Coil Winder

1.0 Purpose and Scope

1.1 To provide instruction in the operation of the Short Coil Winder (Winder) located in Building 924.

2.0 Responsibilities

2.1 Authorized operators (Operators) of the Winder shall perform the tasks described here. A list of Operators is maintained by the Cognizant Technical Supervisor.

2.2 The Operator shall read and complete the following documentation:

2.2.1 Daily Log Book for Coil Programs. Entries shall include any information that the Operator deems important to pass along to the Coil Fabrication Supervisor, the Cognizant Engineer (CE), or the next work shift, including:

A. work accomplished regarding coil production;

B. coil discrepancies;

C. repairs to the Winder (brief description);

D. lessons learned;

E. irregularities during operation of the Winder.

2.2.2 Maintenance Log. Entries shall include:

A. Each repair and maintenance procedure;

B. Parts and material used.

2.2.3 Traveler associated with the coil being wound.

2.2.4 Interlock Test Form.

3.0 Prerequisites

3.1 Training

3.1.1 Operators shall be instructed by the Coil Winding/Curing Technician Supervisor before using this Procedure.

3.1.2 Operator shall be trained as an "knowledgeable employee" as defined by ESH Standard 1.5.1., "Lockout/Tagout Requirements".

3.2 Equipment

3.2.1 Safety glasses with side shields, or goggles.

3.2.2 15 mil shim for lump detector set up.

4.0 Precautions

4.1 Verify that all guards and shields are in place.

4.2 Verify that work area within the yellow border is clear of unauthorized personnel.

4.3 Wear eye protection while cable is under tension.

4.4 Do not wear loose clothing or hanging jewelry. Keep long hair tied up.

4.5 Test the interlocks on a six month interval. The test method is described in Section 5.12.

4.6 Verify that the cable is threaded through the guide wheels as per Attachment 3.

4.7 Do not press S1, S2, or S3 on the UNIDEX keyboard. Pressing these keys will crash the computer program. See Section 5.8 to reload program.

5.0 Procedure

5.1 Overview of the Short Coil Winder

5.1.1 The Short Coil Winder provides a means of winding superconducting cable into magnet coils.

5.1.2 The cable is wound off of its spool through a series of guide wheels, then onto a mandrel and centerpost assembly.

5.1.3 The cable spool is mounted to a rotating carriage that can move clockwise or counterclockwise.

5.1.4 The mandrel assembly rests on bearing assemblies attached to the table that allows the mandrel assembly to be rotated toward the east or west.

5.1.5 Carriage and mandrel motion is controlled by the Operator in manual mode or by the Programmable Motion Controller in auto mode.

5.1.6 As the coil is wound, lamination end spacers and copper wedges are inserted between the windings at specified locations to give the coil the proper shape and size.

5.2 Operator Controls

5.2.1 Operator controls are located on the Control Console, the hand-held controller, the winding table, and the Tension Controller.

5.2.2 In this section, capital letters indicate how the controls are marked.

5.2.3 Control Console Upper Section Controls

A. STOP red mushroom push button.
De-activates power to the motor drivers and tension controller.

B. START green push button.
Activates power to the motor drivers and tension controller.

C. WIND/UNWIND selector switch.
Operational only in auto mode; tells the Programmable Controller to wind or unwind.

5.2.4 Control Console Lower Section Controls

A. MANDREL joystick.

Controls direction and speed of mandrel rotation.

B. CARRIAGE joystick.
Controls direction and speed of carriage rotation.

C. TABLE joystick.
Not operational.

5.2.5 UNIDEX 400 Programmable Motion Controller

Refer to the UNIDEX 400 instruction manual.

5.2.6 Displays

A. Top Display.
Displays number of turn being wound.

B. Bottom Display.
Displays part numbers to be installed at either end of coil.

5.2.7 Remote Controls

5.2.7.1 Hand Held Remote Controller

A. STOP red push button.
De-activates power to motor drivers and tension controller.

B. FEED/HOLD toggle switch.
Operational only in AUTO mode. Placing the switch to the HOLD position will interrupt program execution. Carriage and mandrel motion will stop. The Tension Controller will remain activated, so that the cable will remain under tension.

Placing the switch back to the FEED position will cause motion to resume from where it was put on HOLD. This switch is normally kept in the FEED position.

C. CONTINUE black push button.
Operational only in AUTO mode. Depressing CONTINUE will cause motion to resume after the Programmable Motion Controller has halted the carriage at either end of the table.

5.2.7.2 Table Mounted Control Switches Installed at Either End of Table

A. STOP red mushroom push button, FEED/HOLD toggle switch, and CONTINUE green push button operate exactly as the same controls on the hand-held controller (5.2.7.1).

5.2.8 Cable Tension Controller (TRAC-1) Controls

A. POWER ON/OFF toggle switch.
Turns power on or off to the Tension Controller system.

B. TENSION CONTROL ON/OFF toggle switch.
Activates or deactivates power to the cable tension clutch.

C. TENSION CONTROL Potentiometer and display.
Adjusts force exerted by cable tension clutch; display shows cable tension in pounds.

D. AUTO/MANUAL toggle switch.
Allows control of tension from the TRAC-1 front panel controls (MANUAL) or from an external Programmable Controller (AUTO).

5.2.9 Lump Detector

A. Power ON/OFF toggle switch.
Controls power to the lump detector.

B. Black reset push button.
Resets the audio alarm.

C. Voltage potentiometer.
Adjusts voltage to activate audio alarm.

D. DC voltmeter.
Not used.

E. TRAC-1/BODINE keyed selector switch (not functional).

5.3 Initial Control Settings

5.3.1 ON/OFF rocker switch on the UNIDEX 400 in the OFF position.

5.3.2 POWER ON/OFF and TENSION CONTROL ON/OFF toggle switches on the TRAC-1 Tension Controller in the OFF position.

5.3.3 TENSION CONTROL potentiometer on the TRAC-1 set to zero.

5.3.4 AUTO/MANUAL switch on the TRAC-1 Tension Controller set to MANUAL.

5.3.5 Place all FEED/HOLD switches in the HOLD position.

5.3.6 Lump Detector ON/OFF switch placed in OFF position.

5.4 Before Activating Power to the Winder

5.4.1 Verify that controls are set to their "initial" settings (5.3)

5.4.2 Verify that the interlocks have been tested within the past six months. An Interlock Test Form is posted near the Winder.

5.5 Manual Mode

5.5.1 To Activate Power to the Winder

5.5.1.1 Ensure circuit breaker #15 on electrical panel A7-1 is on. Place MAIN INPUT DISCONNECT switch in the ON position. The MAIN POWER DISCONNECT switch is located on the right side of the control console.

5.5.1.2 Verify that the amber AC POWER light on the console is illuminated.

5.5.1.3 Depress the green START push button on the control console and verify that the MOTOR POWER red light on the console illuminates.

5.5.1.4 Activate power to the UNIDEX 400 by placing the red lighted rocker switch in the ON position.

5.5.1.5 Select MACHINE mode of operation by pressing the F5 key on the UNIDEX 400. Wait 2 seconds.

5.5.1.6 Select SLEW mode (Joystick operation mode) by again pressing the F5 key.

5.5.2 To Set Cable Tension

5.5.2.1 Verify that the cable is anchored in the center post of mandrel. Place the TRAC-1 Tension Controller POWER ON/OFF toggle switch in the ON position.

5.5.2.2 Verify that the TRAC-1 TENSION CONTROL potentiometer is set to zero. Place the TENSION CONTROL ON/OFF switch in the ON position.

5.5.2.3 Set the desired tension as referenced in the MAP by adjusting the tension control potentiometer. The tension, in pounds, will be displayed in the display panel.

5.5.3 To Rotate the Carriage

5.5.3.1 Operate the CARRIAGE joystick. Deflection of the joystick will determine speed. Move the carriage around the semi-circular table ends at a slow and steady speed. If a velocity or integral trap occurs, it will be displayed on the UNIDEX display. Depress the RESET push button on the UNIDEX 400 and repeat steps 5.5.1.5 and 5.5.1.6.

5.5.4 To Rotate the Mandrel

5.5.4.1 Operate the MANDREL joystick. Deflection of the joystick will determine speed. If a velocity or integral trap occurs, it will be displayed on the UNIDEX display. Depress the RESET push button on the UNIDEX 400 and repeat steps 5.5.1.5 and 5.5.1.6.

5.6 Auto Mode

NOTE:

To expedite the Homing operation, it is preferred to have the carriage at or near the "X" position marked on the LEAD END of the table. This should be done using Manual Mode (Joystick operation) as described in Section 5.5

5.6.1 To Activate Power to the Winder

5.6.1.1 Verify that the initial settings are as per Section 5.3. Place MAIN POWER DISCONNECT switch in the ON position.

5.6.1.2 Check that the amber AC POWER light on the console is illuminated.

5.6.1.3 Place the AUTO/MANUAL switch located on the TRAC-1 tension controller box, in the AUTO position.

5.6.1.4 Depress the green START push button on the control console and verify that the MOTOR POWER red light on the console illuminates.

5.6.1.5 Activate power to the UNIDEX 400 by placing the red lighted rocker switch in the ON position.

5.6.1.6 Select "MACHINE" mode of operation by pressing the F5 key on the UNIDEX 400.

5.6.1.7 Select "RUN" mode of operation by pressing the F4 key on the UNIDEX 400.

5.6.1.8 If program reads "SINGLE" press F3 to bring it in AUTO Mode.

5.6.1.9 The UNIDEX 400 display will show File (0 to 9900): Type program file # as mentioned in the applicable Magnet Assembly Procedure and press ENTER. The UNIDEX 400 will execute the winder control program stored in that file #. It will display the following message:

"TYPE 1 to start fresh winding TYPE 2 to wind after BREAK"

NOTE 1:

Enter 1 to begin winding a coil (see Section 5.7). After 1 is entered the carriage and the mandrel will start moving towards their Home position. The Home position for the carriage is the LEAD END of the table and the Home position of mandrel is when the center post is vertically up. When these positions are reached X(carriage) and Y(Mandrel) counters on the display of the UNIDEX 400 are reset to zero.

NOTE 2:

Enter 2 to resume winding a coil that is in progress after a power failure or if the controller is restarted after winding some turns on the coils (see Section 5.8).

5.7 To Start Fresh Winding

WARNING

Step 5.7.1 will cause the carriage and mandrel to move. Stand clear of the table during machine motion.

NOTE:

The FEED/HOLD switch is not operational during the homing operation. To stop machine motion, use the STOP mushroom push button or the STOP push button on the hand-held controller.

5.7.1 Type 1 and press ENTER. The Homing operation will start.

5.7.2 After the carriage and mandrel reach the Home position, anchor the cable.

5.7.3 Place the TRAC-1 TENSION CONTROLLER POWER ON/OFF switch and TENSION CONTROL ON/OFF switch in ON position.

5.7.4 Set Lump Detector as per Section 5.10.

5.7.5 Place all FEED/HOLD switches to FEED.

5.7.6 Press CONTINUE. The carriage will start moving. It will stop at either end of the table for installation of parts (wedges, end-spacers,...). The

name and part number of the appropriate part to be installed will be displayed on the lower display panel. The turn number will be displayed in upper display panel.

5.7.7 The carriage and the mandrel motions can be stopped in between the programmed stops by placing the FEED/HOLD toggle switch in the HOLD position. When the switch is placed back to the FEED position, motion will resume.

5.7.8 To unwind, wait until the carriage comes to its programmed stop at either end of the table. Place the WIND/UNWIND selector switch on the control console to the UNWIND position and press CONTINUE. The carriage and mandrel will now start moving in the reverse sequence.

5.7.9 After the programmed number of turns, the carriage and the mandrel will stop. The lower display will show "WINDING DONE". The program will end and the controller will return to the menu.

5.7.10 During the winding operation, if cable tension deviates by more than 10 lbs. for more than 3 seconds from the set value, a beeper will sound for 3 seconds to alert the operator. The lower display shows TENSION FAULT. The operator should stop the motion by placing the FEED/HOLD toggle switch in the HOLD position, and check the tension reading on the TRAC-1 box. Tension fault monitoring is not provided during UNWIND operations.

5.8 To Wind or Unwind After a Break

In unusual circumstances like a complete power failure or TRAP FAULTS (see Instruction Manual for the UNIDEX 400), it is necessary to power up the winder with some turns of the coil already on the mandrel. In such a case, perform the following steps to complete the winding.

5.8.1 Power up the Winder in MANUAL mode as specified in Section 5.5.

5.8.2 Using joystick control, position the carriage at the specific turn mark corresponding to the number of complete turns on the mandrel. Turn marks are marked at the Lead End of the table.

5.8.3 Using joystick control, position mandrel such that center post is perfectly vertical.

5.8.4 Abort the MANUAL mode by pressing F4.

5.8.5 Set the TRAC-1 Tension Controller AUTO/MANUAL switch to AUTO.

5.8.6 Perform steps 5.6.1.8 to 5.6.1.10. After "2" is entered in step 5.6.1.10, the UNIDEX 400 controller will display the following message:

"TYPE NUMBER OF TURN TO BE WOUND"

5.8.7 Type the number of the turn being wound on the mandrel and press ENTER.

5.8.8 Set the WIND/UNWIND switch to the desired operation and press CONTINUE. The winder now operates in AUTO mode and can be controlled as described in Section 5.7.

5.9 Calibration TRAC-I Cable Tensioning System

NOTE 1:

This procedure should be performed by an Authorized Operator at the start of every production run and once a month thereafter during production.

NOTE 2:

Adjustment of the TRAC-1 system should be performed by a qualified Calibration Technician with a generic Energized Work Permit.

5.9.1 Secure a 2-3 foot length of cable to the mandrel centerpost. The type of cable should match the tooling.

5.9.2 Attach force gage to cable.

5.9.3 Mount spool of cable to carriage.

5.9.4 Run cable through guide wheels. (See attachment 3) Attach to other end of force gage.

5.9.5 Position carriage so that cable is in a straight line parallel to the centerpost from the last guide wheel, through the force gage, to the point of attachment on the centerpost.

5.9.6 Rest the gage on the mandrel. Zero the gage.

5.9.7 Turn on the tension controller as per section 5.5.2.

5.9.8 Adjust the potentiometer until the force gauge reads 5 lbs.

5.9.9 Record the "actual" tension (force gauge reading) and the tension shown on the TRAC-1 digital display in the Short Winder Log Book.

5.9.10 Increase the tension in 5 lb. increments as read on the force gauge, recording the actual tension and the TRAC-1 displayed tension at each point.

5.9.11 Repeat step 5.9.10 until a tension of 45 lbs., as read on the force gauge, is reached.

5.9.12 IF all of the readings are within the Specified Tolerance of "2.5 lbs.,

THEN perform the following steps:

5.9.12.1 Dismantle the set-up.

5.9.12.2 Check off, date, and initial the "TRAC-1 Calibration" form posted on the Winder (Attachment 4).

5.9.12.3 Note in the Short Winder Log Book that no adjustment to the system was required.

5.9.13 IF one or more readings are outside the Specified Tolerance of "2.5 lbs.,

THEN perform the following steps:

<*Calibration Technician:*

WARNING

You will be exposed to 120 VAC line voltage during the performance of steps 5.9.13.1 and 5.9.13.2. An Energized Work Permit is required.

5.9.13.1 Open the TRAC-1 cover.

5.9.13.2 Adjust the TRAC-1 tension controller by following the instructions in the TRAC-1 Instruction Manual, page 8.

5.9.13.3 Close and secure the TRAC-1 cover.

5.9.13.4 Check off and initial the "TRAC-1 Calibration" form posted on the Winder.

<*Operator:*

5.9.14 IF the Calibration Technician is able to adjust the TRAC-1 so that all readings are within the Specified Tolerance,

THEN perform the following steps:

5.9.14.1 Record the final readings in the Log Book. Note in the Log Book that the system was adjusted to within spec.

5.9.14.2 Dismantle the set-up.

5.9.14.3 Check off, date, and initial the "TRAC-1 Calibration" form posted on the Winder.

5.9.15 IF the Calibration Technician is NOT able to adjust the TRAC-1 so that all readings are within the Specified Tolerance,

THEN perform the following steps:

5.9.15.1 Immediately inform the Cognizant Engineer and the Coil Fabrication Supervisor.

5.9.15.2 Do not dismantle the set-up before consulting with your supervisor. Others may want the opportunity to verify your findings.

5.9.15.3 Note in the Log Book that the system could not be adjusted to within spec.

5.9.15.4 Check off, date, and initial the "TRAC-1 Calibration" form.

5.10 Set-Up of Lump Detector

5.10.1 Set Lump Detector Power switch to ON.

5.10.2 Insert 15 mil shim between cable and detector.

5.10.3 Adjust Voltage Potentiometer counter clockwise until alarm trips.

5.10.4 Hit reset. If alarm does not stop, adjust voltage potentiometer downward in small increments, hitting reset button at each increment, until alarm stays off.

5.10.5 Remove shim. The Lump Detector alarm is set.

5.11 Film Wrapping

5.11.1 Power up the Winder in AUTO mode as described in Section 5.6.1. Perform steps 5.6.1.1 to 5.6.1.7.

5.11.2 The UNIDEX 400 display will show 'ENTER FILE #'. Type 2 and press ENTER.

5.11.3 Depress CONTINUE. The mandrel will now rotate continuously. Use the FEED/HOLD switch to stop the mandrel at the desired position.

5.11.4 After wrapping is done, depress ABORT (F4) on the UNIDEX 400 front panel.

5.11.5 Place the FEED/HOLD switch in the FEED position after program is aborted.

5.12 Interlock Test Procedure

NOTE 1:

Two operators, designated "Operator 1" and "Operator 2", are required to perform this section.

NOTE 2:

The interlock test procedure should be performed at a six month interval.

<*Operator 1:*

5.12.1 Set all controls to their "initial" settings (5.3).

5.12.2 Activate the Winder in the Manual Mode (5.5).

WARNING

Failure to follow step 5.12.3 could result in unexpected machine motion and possible injury.

5.12.3 Verify that the TENSION CONTROL potentiometer, located on the TRAC-1 box, is set to zero.

5.12.4 Set the TRAC-1 Tension Controller POWER ON/OFF and TENSION CONTROL ON/OFF toggle switches to ON.

5.12.5 Set the TENSION CONTROL potentiometer to 2 lbs. of tension, as displayed on the digital display. The spool holder should rotate.

5.12.6 Move the carriage and mandrel using the joystick controls.

5.12.7 While the spool holder, carriage, and mandrel are in motion, depress the STOP push button on the control console.

5.12.8 IF all machine motion stops,

THEN check the appropriate box on the Interlock Test Form (Attachment 2).

5.12.9 IF all machine motion does not stop,

THEN stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

WARNING

Personnel should stand away from the spool holder before step 5.12.10 is performed.

5.12.10 Depress the green START push button on the control console. The spool holder should rotate.

5.12.11 Move the carriage and mandrel using the joystick controls.

<*Operator 2:*

5.12.12 While the spool holder, carriage, and mandrel are in motion, depress the STOP push button on the hand-held controller.

<*Operator 1:*

5.12.13 IF all machine motion stops,

THEN check the appropriate box on the Interlock Test Form.

5.12.14 IF all machine motion does not stop,

THEN stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

5.12.15 Depress the green START push button on the control console. The spool holder should rotate.

5.12.16 Move the carriage and mandrel using the joystick controls.

<*Operator 2:*

WARNING

The next step requires that you stand within the yellow border. Do not allow your clothes or body to come in contact with any moving parts. Do not linger in the area or become distracted.

5.12.17 While the spool holder, carriage, and mandrel are in motion, and while the carriage is moving away from you, step next to the table and depress the STOP push button on the Winder table.

<*Operator 1:*

5.12.18 IF all machine motion stops,

THEN check the appropriate box on the Interlock Test Form.

5.12.19 IF all machine motion does not stop,

THEN stop work, write "fail" on the Interlock Test Form, and notify the Cognizant Engineer, the Cognizant Technical Supervisor, and the ES&H Coordinator.

5.12.20 Repeat steps 5.12.15 to 5.12.19 for the other STOP push button on the Winder table.

5.12.21 Initial and date the Interlock Test Form. Post the Form near the Winder.

5.13 Maintenance Procedure

5.13.1 Inspect carriage bearings. Replace bearing as necessary. Add grease as required.

5.13.2 Inspect chains, sprockets. Adjust tension as necessary.

5.13.3 Inspect drive mechanisms, shaft, journals that engage mandrel.

5.14 To Shut Down the Winder

5.14.1 Set the controls to Initial Control settings per Section 5.3.

5.14.2 Place the MAIN POWER DISCONNECT switch in the OFF position.

5.14.3 Complete Coil Winder log book.

6.0 Documentation

6.1 Coil Winder Log Book.

6.2 Magnet Travelers.

6.3 Interlock Test Form.

6.4 Maintenance Log.

6.5 Magnet Assembly Procedure

7.0 References

7.1 ESH Standard 1.5.1., "Lockout/Tagout Requirements"

7.2 ESH Standard 1.5.0., "Electrical Safety"

7.3 Instruction Manual for UNIDEX 400 Motion Controller

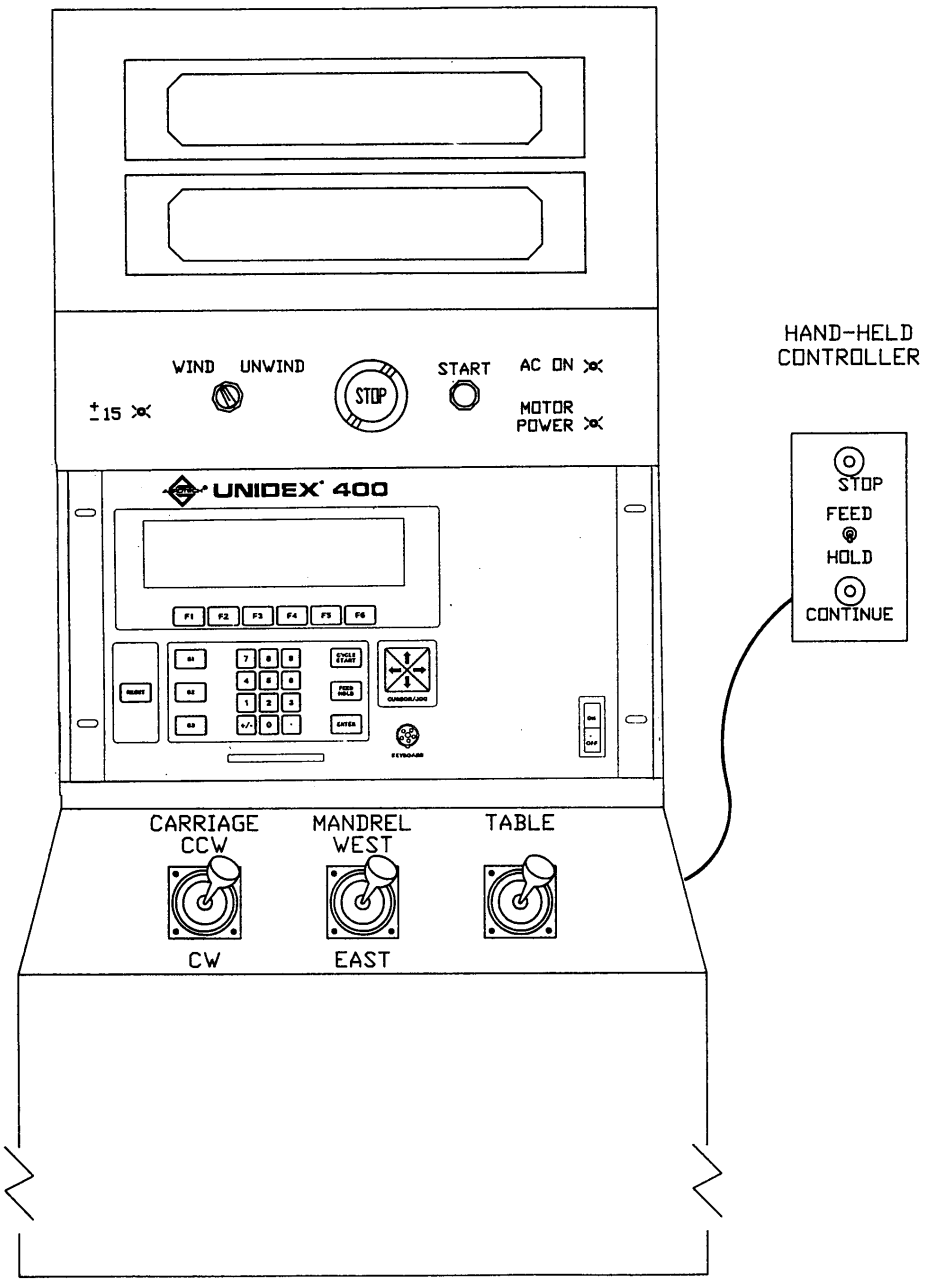
7.4 Magpower TRAC-1 Instruction Manual

8.0 Attachments

1. Control Console Diagram
2. Interlock Test Form
3. Cable and Guide Wheel Diagram
4. TRAC-1 Calibration Form

Attachment 1

Control Console Diagram



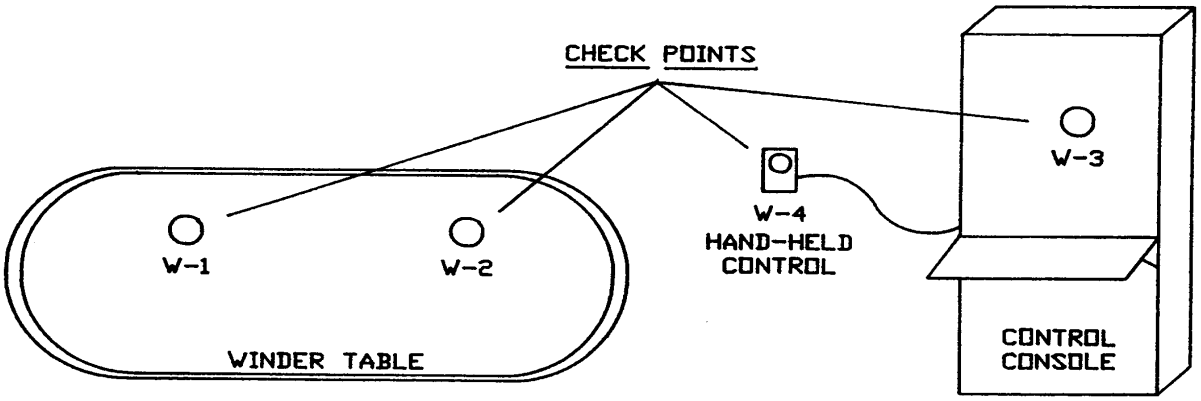
Attachment 2

Interlock Test Form

Instructions:

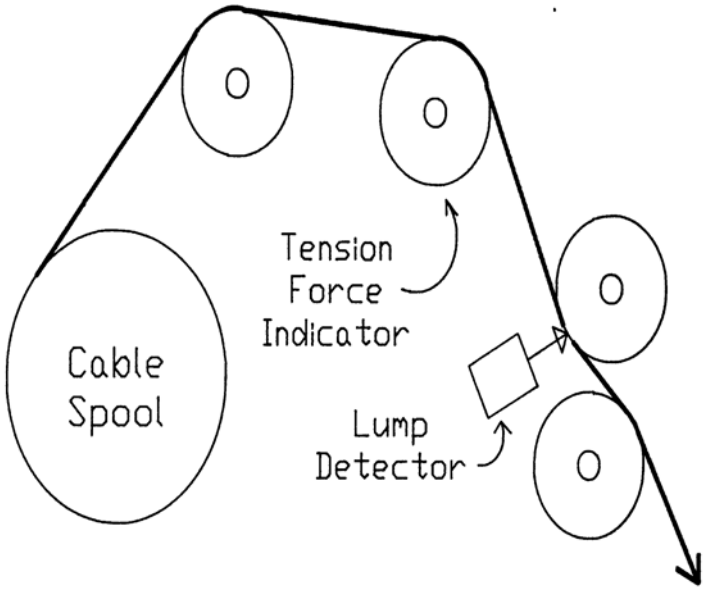
1. Post this form near the Winder.
2. Do not operate the Winder if the interlocks have not been tested within the past six months.
3. Refer to the Operations Procedure for the Winder for the proper interlock test method.
4. Check box as each device is tested. Initial and date the form. If an interlock fails the test, write "fail" in the appropriate box, and notify the Cognizant Engineer and the ES&H Coordinator immediately.

W-1										
W-2										
W-3										
W-4										
INIT.										
DATE										



Attachment 3

Cable and Guide Wheel Diagram



Attachment 4

TRAC-1 Calibration Form

Notes:

1. Calibration Procedure: RHIC-OPM 8.1.1.19, section 5.9.
2. Specified Tolerance: ±2.5 lbs.
3. See Short Winder Log Book for data.

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments:

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments:

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments:

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments:

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments:

Check one:

No adjustment required.............<>	Date	________
Adjusted to within spec............<>	Operator Initials	________
Could not adjust to within spec.....<>	Calib. Tech. Initials	________

Comments: